A MOBILE PHONE COMPANION APPARATUS TO PROVIDE VOICE LINK WITH LAND-LINE HOUSE TELEPHONE

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Cross-Reference

US PATENT DOCUMENTS

4,658,096 4/14/1987 West et al.

5,715,296 2/3/1998 Schornack et al.

5,946,616 8/31/1999 Schornack et al.

Statement Regarding Federally Sponsored Research or Development

The claimed invention is not sponsored by federal research and development grant.

BACKGROUND AND PRIOR ART

Description of the Prior Art

Existing products, such as Phonecell SX4e FWT for GSM 1900 and Phonecell SX4D Desktop phone for TDMA 800 manufactured by TELULAR Corp. and described in U.S. Pat. No. 5,946,616 issued on Aug. 31, 1999 and U.S. Pat. No. 5,715,296 issued on Feb. 3, 1998, focus on decoupling RF circuit loop and land-line circuit loop on a fixed wireless telephone set.

US Pat. No. 4,658,096 issued to West et al. on April 4, 1987 details an interface system for interfacing a telephone set with a RF transceiver as part of telephone network.

The fixed wireless telephone set requires build-in RF function in order to receive and transmit RF signal to communicate with mobile phone service provider's station. Therefore, the fixed wireless hardware requires frequent upgrade for mobile service providers' frequency band changes and wide range of fixed wireless telephone models are needed to work with wireless service providers' many mobile network systems, e.g., GSM, TDMA, and CDMA.

Users of fixed wireless telephone set are required to keep up with the costly hardware upgrade to replace outdated product in order to utilize newer services and better mobile phone quality provided by wireless service providers.

BRIEF SUMMARY OF THE INVENTION

The invention, called Personal Mobile Companion (***PMC***), presented is fully compatible with all mobile network standards and mobile handsets, using different frequency bands, provided by various wireless service providers. It will not be necessary to replace the ***PMC*** due to mobile phone upgrade because only mobile phone's analog voice signal is needed as input for ***PMC*** to carry out conversation between calling parties. The ***PMC*** provides a low cost mean to enable the use of house land-line telephone set to receive wireless signal and carry out phone conversation on land-line telephone set through individual's own mobile telephone, as shown in **Fig. 1**.

The ***PMC*** is composed of three major components, as shown in **Fig. 2A**, that include (*A*) a power supply unit which converts the regular household 110V AC power source to an 11V DC; (***B***) a voltage driver component that splits the 11V DC into an 8V DC to drive house land-line telephone headset components and a 11V DC for ***PMC*** ring tone circuit controller to control ring tone signal on household phone; and (*C*) a ring tone circuit controller which uses the ring tone signal from mobile phone headphone outlet to activate ***PMC*** ~~ring generator~~ Ring Tone Generator (***RTG***) in order to send out repeated AC signal to drive the ringer on land-line telephone set. The voltage driver splits an incoming DC voltage into two separate power sources, an 8V DC for land-line telephone handset and an 11V DC for ring tone circuit, as shown in **Fig. 2B**. The ring tone circuit controller, shown in **Fig. 2C**, ~~also~~ includes a ***RTG*** unit (*F*) to create a 6 seconds voltage cycle for land-line telephone and an impedance variation detector (***G***) to detect resistance change, when house land-line telephone headset is picked up by receiving party, and shut off the AC current for ring tone.

The ***PMC*** unit delivers 8V DC along with the 12V AC generated by the ring tone circuit controller when incoming call to mobile phone was first detected and ring signal was automatically delivered from mobile phone through the headphone connection to ***PMC***. Mobile

phone unit is normally programmed to automatically answer incoming call, after preset ring cycles, when a headphone unit is plugged into the headphone outlet. The 12V AC will then activate the ringer on the land-line telephone unit to inform receiving party of the incoming call onto the connected mobile phone. While the 8V DC current is blocked by the ringer capacitor on the land-line telephone, the calling party will continue to hear ring signal feedback, generated by a ring tone generator (***RTG***) shown in **Fig. 3D**, before the receiving party picks up the land-line telephone headset. When the receiving party picks up the land-line telephone headset, the 8V DC current will then flow through the closed loop and activate the speech circuit on land-line telephone. The adding of speech circuit will thus change line resistance. The Impedance Variation Detector (***IVD***), shown in **Fig. 3E**, will cut off the 11V DC power supply, to the ***RTG*** unit after detecting the change in line resistance. Voice communication between calling and receiving parties are now connected by the 3V AC, from mobile headphone outlet, through **A*** and **B*** lines shown in **Fig. 2C**, alone with the 8V DC generated by PMC handset voltage driver.

At the end of conversation, the 8V DC is shut off after the receiving party put down headset unit to shut off hook switch. Mobile telephone will automatically end the incoming call upon pre-set silence time limit. And the ***PMC*** unit is now back to its ready state to receive another incoming call.

Fig. 2D shows the time sequence waveform chart of each major unit in the ***PMC*** box. These are waveforms generated by cell phone signal, ring tone ~~trigger~~ connecting device **10** (shown in **Fig. 3D**), relay **18** (shown in **Fig. 3D**), clock generator **19** (also shown in **Fig. 3D**), ***IVD (G)*** (shown in **Fig. 2C**) and the ring tone signal driven by **PMC**.

External On/Off switches, **9** shown in **Fig. 3B** and **13** shown in **Fig. 3C**, are also provided to cutoff the 8V DC power supply to a land-line telephone headset and to silence the ring tone.

BRIEF DESCRIPTION OF FIGURES

Fig. 1 Schematic diagram showing how signal is transferred from wireless service provider's mobile tower to handheld mobile telephone, through the claimed apparatus ***PMC*** to house telephone set, or like device.

Fig. 2A Schematic of voice signal processing functional block inside the ***PMC***, the diagram shows how ***PMC*** connects to mobile telephone headphone and to regular land-line house telephone with power input from house wiring power outlet.

Fig. 2B Schematic diagram showing the voltage driver unit ***(B)*** as shown in **Fig. 2A**.

Fig. 2C Schematic diagram showing the ring tong circuit controller unit ***(C)*** in dashed functional block.

Fig. 2D Time sequence waveform chart of major units in the PMC box and their response to land-line user.

Fig. 3A Circuit diagram of the power supply unit ***(A)*** shown in **Fig. 2A**.

Fig. 3B Circuit diagram of the handset voltage driver unit ***(D)*** shown in **Fig. 2B**.

Fig. 3C Circuit diagram of the ***PMC*** ring tone circuit controller voltage driver unit ***(E)*** shown in **Fig. 2B**.

Fig. 3D Circuit diagram of the ***PMC*** Ring Tone Generator (***RTG*)**, shown as unit ***(F)*** in **Fig. 2C**.

Fig. 3E Circuit diagram of the Impedance Variance Detector (***IVD***) shown as unit ***(G)*** in **Fig. 2C**.

Fig. 3F Circuit diagram of a sequential relay unit, e.g., **23**, shown in **Fig. 3D**.

Fig. 3G Circuit diagram of a ring tone ~~triggering~~ <u>connecting</u> device **10** shown in **Fig. 3D**.

DESCRIPTION OF THE INVENTION

The ***PMC*** unit is composed of several major functional circuit components to provide needed electrical current at desirable voltage to drive land-line telephone set in order to inform receiving party of incoming calls and to carry out conversation between calling and receiving parties. These functional circuit units are as follows.

Power Supply Unit; Fig. 3A

Function of this unit is to convert 110V AC from wall outlet to 11V DC and provide stable DC source to power "Voltage driver" and "Ring tone circuit voltage driver" modules, shown as (***D***) and (***E***) in **Fig. 2B**. The unit is composed of an 8:1 transformer **1**, a bridge rectifier **2-5**, a capacitor filter **7**, a surge resistor **6** and an 11V Zener diode **8**. An 8:1 transformer **1** transforms the 110V AC to 24.74V AC, as the 2nd peak voltage. The 2nd peak voltage then passes through the full wave bridge rectifier **2-5**, results in an output voltage of 14.86V AC. Capacitor filter **7** acts as ripple remover with capacitance ranging from several hundreds to thousand uF. Resistance **6** is the current limiting resistor for surge current reduction. An 11V Zener diode **8** is attached before the power supply output end to ensure stable DC voltage output **VD**, as shown in **Fig. 2B**.

8V Voltage Driver; Fig. 3B

Function of this module is to supply DC voltage needed to drive the speech circuit of the land-line telephone handset circuit. The power driver is composed of a Zener diode **11** and one capacitor **12**, see **Fig. 3B**. Zener diode **11** of this circuit acts as an 8V voltage regulator and capacitor **12** is to remove any residual AC noise. An external On/Off switch **9** is provided to turn on or off the voltage driver unit.

11V Voltage Driver; Fig. 3C

Function of this module is to supply DC voltage needed to drive the ringer of land-line telephone handset circuit. Also, it acts as the power supply for two key modules in the ***PMC*** box, they are the Impedance Variation Detector (***IVD***) and the Ring Tone Generator (***RTG***). The driver is composed of one Zener diode **14** and one capacitor **15**, see **Fig. 3C**. Zener diode acts as voltage stabilizer and capacitor **15** is to remove any residual AC noise. On/Off switch **13** is an external switching unit to turn on or off the voltage driver unit.

Ring Tone Generator; Fig. 3D

The function of the ***RTG*** is to provide repeating ring tone AC signal to trigger the land-line telephone ringer to inform the receiving party of incoming calls through mobile phone, while voice AC is fed into wall jack. Signal of ring tone is a repeating ~~of~~ 6 seconds cycle, 2 seconds are

high voltage at 12V AC **17** and 4 seconds are +0 Volt or low voltage AC **16**. Upon receiving the first cycle of ringer signal from mobile phone headphone outlet, the ***PMC*** unit will continue to provide the ring ~~T~~tone ~~S~~signal ~~C~~cycles, as shown in **Fig. 3D**, to land-line telephone through line **A*** until the receiving party answers the phone. To provide the correct cadence from the ***PMC*** box, the ***RTG*** module is composed of six shift registers **34-39,** five relays **23-27**, six amplifiers **28-33**, and one clock generator **19**. Resistor **20** and capacitor **21** are the coupling devices of clock signal generator **19**. The six ring tone voltage amplifiers and shift registers will record and replay the preset tone voltage level which corresponds to the repeating 6 seconds interval. In any of the register, D0 represents the data input voltage and Q0 represents the output voltage. **34** and **35** are the high(**H**) input voltage level and **36-39** are the low(**L**) input voltage level of the 6 seconds cycle. Note that **17** represents the first two seconds of high voltage and **16** represents the last four seconds of low voltage in the 6 seconds cycle. Register voltage timing control is done by a relay **23**, which consists of a ~~resistor~~ capacitor **65a**, a ~~capacitor~~ resistor **65b**, and an inductor **65C**, as shown in **Fig. 3F**, and a clock signal generator **19** shown in **Fig. 3D**. Mechanical relay **18** is the output control device from ***IVD***, also shown in **Fig. 3E**. Relay **18** is normally ON (**NO**) and receives power supply from a ring tone ~~trigger~~ connecting device **10**, shown in **Fig. 3D** and detailed in **Fig. 3G**. With both **10** and **18** at ON position, power supply is then send to clock signal generator **19** and subsequently creates the 6 seconds high/low voltage cycles to trigger land-line ringer. Relay **18** is controlled by ***IVD*** through voltage output line **22** of the connecting device **10** to turn off the 11V DC supply to the clock generator **19**, and subsequently turn off the sequential register circuitry as soon as the receiving party picks up the phone. See the time chart shown in **Fig. 2D** for the operating sequence of relay and ring tone control.

The duration of clock signal generated by **19** is 6 seconds per cycle. The first second is at high voltage level **40** and the next 5 seconds are at low voltage level **41**. The first high voltage level signal will trigger register **34** and start to charge relay **23**. Relay **23**, with embedded RC time delay circuitry, will be triggered at the 2^{nd} second, and then relays **24-27** will be trigger sequentially in the next 4 seconds. Hence generates a 6 second voltage pulse cycle, shown as the **17** and **16** voltage cycle in **Fig. 3D**, to be send to the land-line telephone set.

Impedance Variation Detector; Fig. 3E

Function of this unit (G), shown in **Fig. 2C**, is for detecting the land-line telephone handset hook switch On/Off status and to control the ***RTG*** module (F) to keep on generating the tone signal until the handset is picked up by receiving party. The mechanism of the circuit is designed to detect the impedance variation before and after the handset switch-hook of the land-line house telephone set speech circuit is engaged and ready to receive the voice signal input from **A*** and **B***, shown in **Fig. 2C**. Note that unit **61** of **Fig. 3E** is the ***RTG*** module (F) of **Fig. 2C**. Major components of this circuit include one high pass filter (consists of one resistor **45**, one induction coil **46**, and one capacitor **47**), one Wheatstone bridge (consists of four resistors **53-56**), a differential amplifier **59** and a mechanical relay ~~**60**~~ **18** to control the ***RTG*** module. **42** represents the total resistance from the land-line telephone circuit. Terminals **A*** and **B*** in **Fig. 3E** are connected to the signal AC output of the ***PMC*** box, which is also connected to land-line telephone set. Capacitors **43** and **44** are used as the DC isolators. A high pass filter is used to attenuate any low frequency signal in the human voice domain. Two additional capacitors **49** and **51** were added to the circuit to remove high frequency noise signal. Two diodes **48** and **52** are used to regulate the current direction and make the parasitic AC voltage to positive. Then, the circuit was attached to one side of the Wheatstone bridge, in parallel with resistor **56**. When the land-line telephone switch hook is depressed by telephone handset, the impedance seen by Wheatstone bridge will be the total impedance in the ***PMC*** circuit in serial with the ringer circuit of the land-line telephone unit. Power of the bridge is supplied by Vdd **57** from voltage driver. Once the receiving party picks up the land-line telephone handset, the total impedance will be shunt by the speech circuit resistance **42**. The variation of the impedance will then be detected by the Wheatstone bridge. Since the Wheatstone bridge is also connected to the input of a differential amplifier **59** from the other side, the difference of the input voltage will be amplified from the output terminal of the differential Amp to drive the relay unit **18**. Power for amplifier **59** is supplied by +Vcc **58** and –Vcc **62** from the 11V DC generated by the ring tone circuit voltage driver. The function of relay **18** shown in **Fig. 3E** is to turn off the power of ***RTG*** module as soon as variation of impedance is detected. **18** has one inductor unit **60a** and three terminals, NO **60b**, CO **60c**, and NC **60d**.

Relay Unit; Fig. 3F

The mechanism of the first relay unit **23**, connecting to register **35** and then to amplifier **29** as shown in **Fig. 3D**, is explained next. A capacitor **65a** and a resistor **65b** are arranged in serial to create one second time delay before pulse charge up the induction coil **65c** of the relay unit to trigger register **35**. One second delay will provide sufficient time to space out the signal coming out from the register in 6 seconds interval shown in **16** and **17** of **Fig. 3D**. Then, the voltage pulse from amplifier **29**, as part of the 6 seconds cycle, will be fed into the ringer circuit in the land-line telephone set.

Ring Tone Trigger Unit; Fig. 3G

This device uses the analog ring signal from mobile phone to trigger the voltage needed for clock generator **19** of **Fig. 3D**. Hence, the ring tone signal to the land-line telephone set. The unit is made up of a capacitor **70**, a diode emitter **71**, a transistor **72** and a diode receiver **73** to detect mobile phone ring signal and to eliminate low frequency analog signal. These devices will transfer the ring tone AC voltage to the next triggering circuitry without interfering with the ringer voltage sent out from the mobile phone. The output of transistor **73** equals the input AC signal. Diode **74** is used to regulate current direction. Zener diode **76** is the voltage limiting device and capacitor **75** is the AC high frequency filter. Both devices will maintain fixed voltage threshold and reduce the voltage ripples that feed into the MOSFET transistor **78**. The Zener diode **77** will stabilize input voltage of MOSFET **78**. Then, the transistor will be turned ON and allow 11V DC to trigger the clock signal generator **19** as shown in **Fig. 3D**.

RB, **RE** and **RC** are the resistors used to maintain proper operating DC bias and electrical current (mA) flow for transistor **72**. **RD** and **RS** are the voltage bias resistors to turn on the MOSFET **78**.